Wireless Spacecraft Bus- A Radio Frequency based data communication architecture

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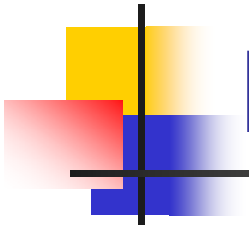


Roadmap

- Motivation
- Objective
- Approach
- Current Progress
- Future Work
- Conclusion

Motivation

- Spacecraft harness accounts for a significant proportion of a spacecrafts dry mass.
  - Spacecraft data harness weight equals 55 %
- Problems with data harness
  - Difficult and labour intensive to manufacture
  - Expensive
  - Difficult to integrate
  - Difficult to test
  - Difficult post-integration testing

Objective

- Develop empirical knowledge of design requirements and performance of wireless systems in the space environment
- Accomplished through laboratory testing and flight demonstration/data gathering.
- The project will be undertaken in three phases.

Phase I

- Design, build and deliver a wireless sounding rocket payload that will utilize one SubSEM payload bay to address the following issues:
  - Influence of sounding rocket launch vehicle acceleration environment on the ability of a low-cost small-scale, wireless sensor network to maintain communications during the launch phase of the flight.
  - Characterization of the radio frequency and space electromagnetic that should be simulated in a ground-based mock satellite environment.

Phase II

- Develop laboratory facilities at ODU and the MIST Pocomoke facility.
- Experimentation will be conducted to address scalability issues associated with space borne wireless sensor networks and will be oriented to demonstrate an open system architecture (OSA) for wireless communications in space.
- The lab will also develop Wireless Local Area Network (WLAN) framework and protocols for larger networks that communicate over greater distances and develop WPAN/WLAN coexistence models and mechanisms.

Phase III

- Dedicated to implementation of education and training agreements and programs that support the Eastern Shore educational institution.
- Old Dominion University will support, coordinate and/or lead wireless education and training programs emanating from the MIST laboratory at Pocomoke, MD.

Phase I – Design Objectives

- Design the preliminary wireless sounding rocket (WPAN) payload
- Procure all necessary hardware and test equipment to support sounding rocket payload construction
- Commission the initial phase of the wireless laboratory at ODU
- Deliver sounding rocket experiment module, be ready for integration and space environmental testing
- Characterize the EMI and radiation environments
- Refine WPAN design and protocols

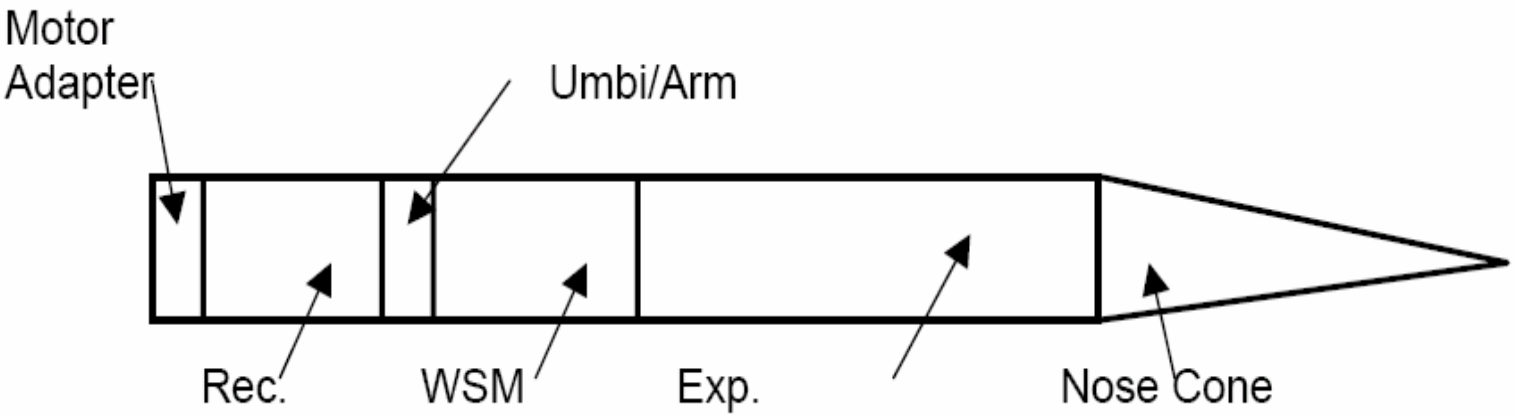
System Components

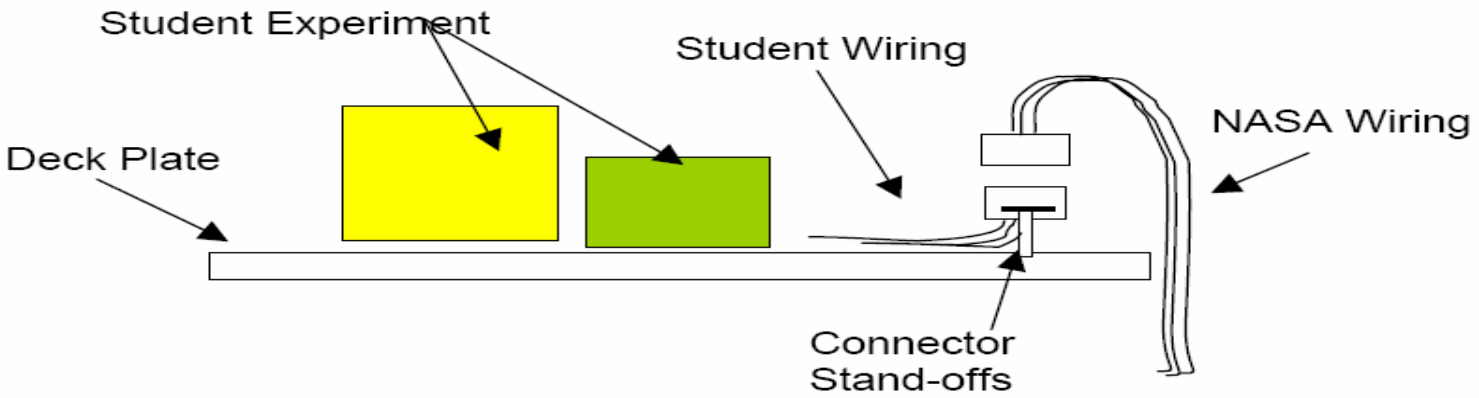
Crossbow Wireless Mote

Crossbow Multi-Sensor Board

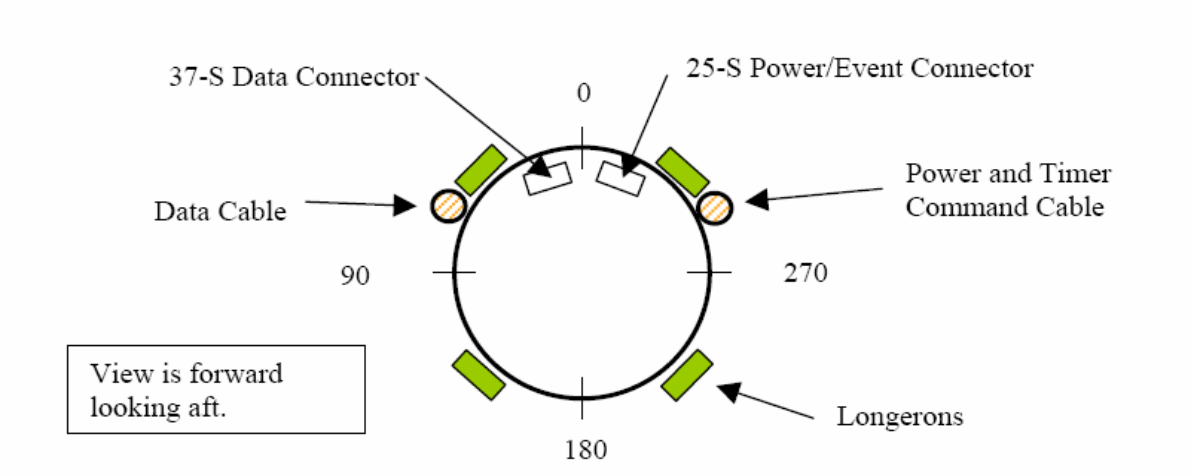
Crossbow Base Station

Sounding Rocket

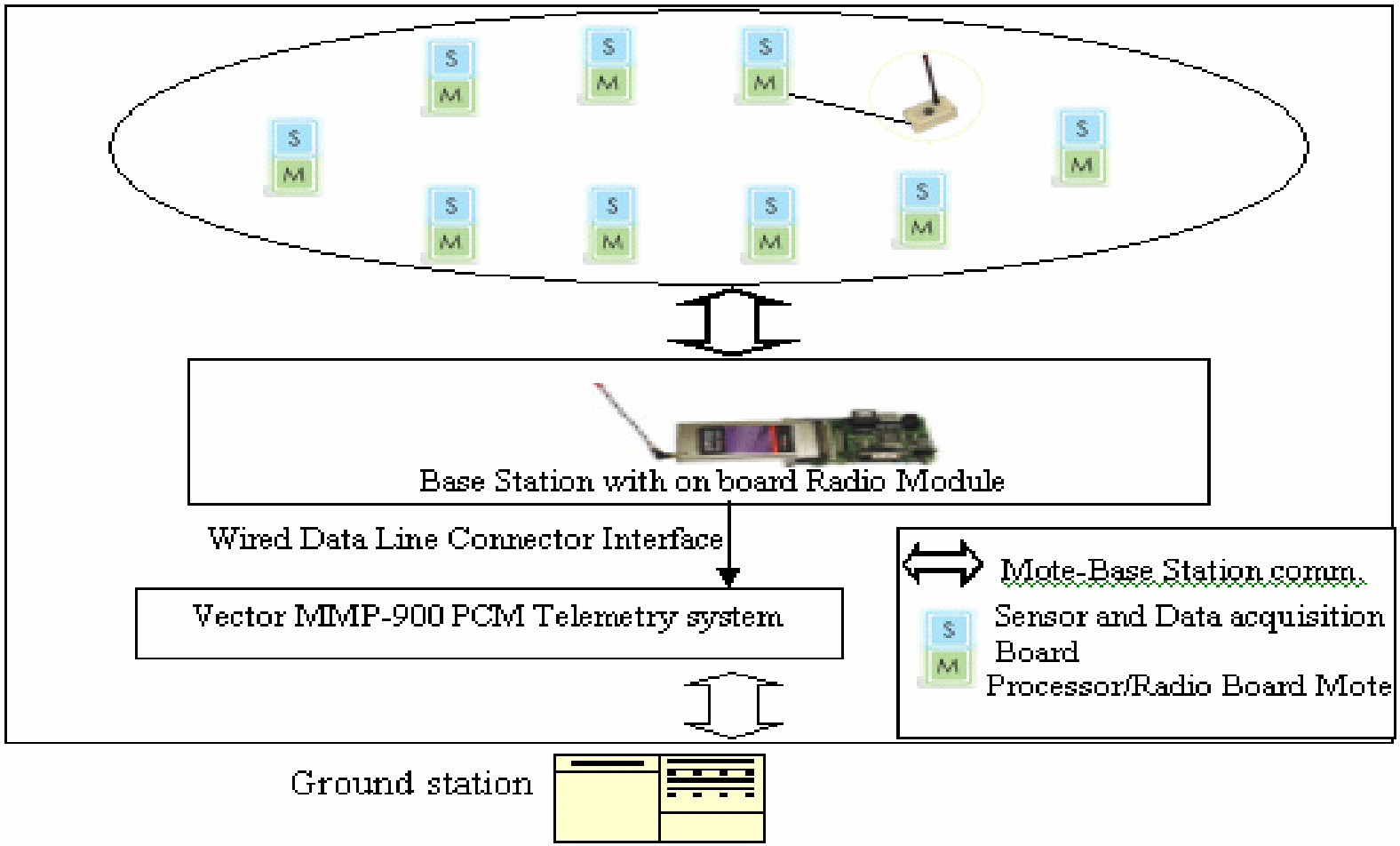




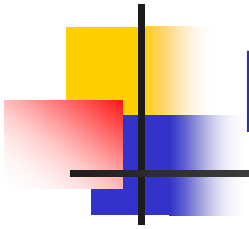
Sounding Rocket



Wireless Data Acquisition on Sounding Rocket



Future Work – Phase II and Phase III



- Investigate effects of electromagnetic radiation on performance of wireless systems/protocols
- Develop a WLAN protocol suitable for spacecraft application
- Develop WPAN/WLAN coexistence models and mechanisms

Phase III

- Establish education and training agreements with Eastern Shore educational institutions
- Design and implement Wireless Sensor Web at MIST Lab
- Support faculty at Eastern Shore institutions in establishing educational products and student involvement